

What Is Claimed Is:

- 1 1. A method of forming a silicon carbide barrier layer on a substrate, comprising:
2 a) introducing silicon, carbon, and a noble gas into a chamber;
3 b) initiating a plasma in the chamber;
4 b) reacting the silicon and the carbon in the presence of the plasma to form
5 silicon carbide; and
6 c) depositing a silicon carbide barrier layer on the substrate in the chamber.
- 1 2. A method of claim 1, wherein the silicon (comprises a silane).
- 1 3. A method of claim 1, wherein the silicon and carbon are derived from a common
2 methylsilane, independent of other carbon sources.
- 1 4. A method of claim 1, further comprising depositing the silicon carbide barrier layer
2 at a temperature of between about 100° to about 450° C.
- 1 5. A method of claim 1, further comprising depositing the silicon carbide barrier layer
2 at a temperature of between about 300° to about 400° C.
- 1 6. A method of claim 1, further comprising producing a silicon carbide barrier layer
2 having a dielectric constant of no greater than about 6.
- 1 7. A method of claim 1, further comprising producing a silicon carbide barrier layer
2 having an (effective) dielectric constant of no greater than about 3.

8. A method of claim 1, further comprising producing a silicon carbide barrier layer which is copper diffusion resistant.

9. A method of claim 1, further comprising producing a silicon carbide barrier layer having a copper diffusion of about 300 Å or less.

10. A method of claim 1, wherein reacting the silicon and the carbon comprises reacting the silicon and the carbon while maintaining a chamber pressure between about 6 to about 10 Torr.

11. A method of claim 1, wherein reacting the silicon and the carbon comprises reacting the silicon and the carbon using an RF power supply supplying a power density of about 4.3 to about 10.0 watts per square ^{inch} ~~centimeter~~ to an anode and cathode in the chamber.

12. A method of claim 1, wherein providing the silicon comprises providing a silane flow rate of between about 10 to about 1000 sccm and providing the noble gas comprises providing a helium or argon flow rate of between about 50 to about 5000 sccm.

13. A method of claim 1, wherein providing the silicon, the carbon, and the noble gas comprises providing a methylsilane flow rate of between about 30 to about 500 sccm as the silicon and carbon source and a helium or argon gas flow rate of between about 100 to 2000 sccm as the noble gas source and further comprising reacting the silicon and the carbon in a chamber pressure range of about 3 to about 10 Torr with an RF power source supplying a power density of about 4.3 to about 10.0 watts per square ^{inch} ~~centimeter~~ to an anode and cathode in the chamber and a substrate surface temperature of between about 200° to about 400° C and having a showerhead to substrate surface spacing of between about 300 to about 600 mils.

174

no property
of structure

09165248-100198

A

A

1 14. A method of claim 1, wherein the silicon carbide barrier layer comprises an etch
2 selectivity ratio of at least about 40 to 1.

1 15. A method of forming a silicon carbide passivation layer on a substrate, comprising:

- 2 a) introducing silicon, carbon, and a noble gas into a chamber;
3 b) initiating a plasma in the chamber;
4 b) reacting the silicon and the carbon in the presence of the plasma to form
5 silicon carbide; and
6 c) depositing a silicon carbide passivation layer on the substrate in the
7 chamber.

1 16. A method of claim 15, wherein the silicon and carbon comprise ~~X~~ methylsilane.

1 17. A method of claim 15, further comprising depositing the silicon carbide barrier
2 layer at a temperature of between about 300° to about 400° C.

1 18. A method of claim 15, wherein reacting the silicon and the carbon comprises
2 reacting the silicon and the carbon using a chamber pressure between about 6 to about 8
3 Torr.

1 19. A method of claim 15, further comprising producing a silicon carbide passivation
2 layer having no substantial penetration of moisture.

1 20. A method of claim 15, wherein reacting the silicon and the carbon comprises
2 reacting the silicon and the carbon using an RF power supply supplying a power density of
3 about 8.6 to about 14.3 watts per square ^{inch} ~~centimeter~~ to an anode and cathode in the
4 chamber.

21. A method of claim 15, wherein providing the silicon, the carbon, and the noble gas comprises providing a methylsilane flow rate of between about 100 to about 500 sccm as the silicon and the carbon source and providing a helium or argon gas flow rate between about 1000 to about 2000 sccm as the noble gas source and further comprising reacting the silicon and the carbon in a chamber pressure range of about 6 to about 8 Torr with an RF power source supplying a power density of about 8.6 to about 14.3 watts per square ^{inch} ~~centimeter~~ to an anode and cathode in the chamber and a substrate temperature of between about 200° to about 400° C and having a gas dispersion head to substrate spacing of between about 200 to about 600 mils.

22. A method of claim 15, wherein the silicon and carbon are derived from a common methylsilane, independent of other carbon sources.

23. A substrate having a silicon carbide layer, comprising:
a) a semiconductor substrate;
b) a dielectric layer deposited on the substrate; and
c) a silicon carbide layer having a dielectric constant of about 6 or less.

24. The substrate of claim 23, wherein the silicon carbide layer comprises an effective dielectric constant of about 3 or less.

25. The substrate of claim 23, wherein the silicon carbide layer comprises a copper diffusion of about 300 Å or less.

26. The substrate of claim 23, wherein the silicon carbide layer comprises an etch selectivity ratio of at least about 40 to 1.

090446-100493
A 7 8 9